NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 3 HRS

Deep-Sea Decisions

Students research members of the team behind the historic *DEEPSEA CHALLENGE* expedition and then take on the role of a team member in a simulation of a deep-sea expedition.

GRADES

6 - 8

SUBJECTS

Arts and Music, Earth Science, Astronomy, Oceanography, Engineering, Geography

CONTENTS

2 Videos, 5 PDFs, 4 Resources, 2 Links

OVERVIEW

Students research members of the team behind the historic *DEEPSEA CHALLENGE* expedition and then take on the role of a team member in a simulation of a deep-sea expedition.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/deep-sea-decisions/

Program

DEEPSEA CHALLENGE

DIRECTIONS

1. Introduce the *DEEPSEA CHALLENGE* expedition by showing the National Geographic News video "James Cameron Breaks Solo Dive Record."

Before viewing the video, provide students with the following focus questions: *What was the* *purpose of the DEEPSEA CHALLENGE expedition? What were some challenges faced by the team?* Ask students to take notes as they watch the video. Use the focus questions to begin a discussion following the video. Have students brainstorm what kind of knowledge it might take to put such a project together and what sorts of professionals would be needed on the team.

2. Have students read the provided article "Top Team"—which describes the *DEEPSEA CHALLENGE* team—and fill out a KWL chart.
Distribute the provided KWL Chart handout, and have students list what they know about the *DEEPSEA CHALLENGE* team in the first column. In the second column, have them list information they would like to know about the team. Have students read the article "Top Team" and add information they learn about the team to the third column. After students have finished reading the article, discuss how James Cameron's description of the team compared to students' brainstorming ideas from step 1.

3. Have students research *DEEPSEA CHALLENGE* team members.
Divide students into five groups and assign each group one of the following *DEEPSEA CHALLENGE* team members: Kevin Hand, Don Walsh, Ron Allum, James Cameron, and Christina Symons. Print and distribute the provided article handouts and/or direct students to the provided websites to find additional information about their assigned expedition team member. Each group member should become an expert on the group's assigned team member. Group members should determine and document the areas of the expedition for which their assigned team member was responsible and the kinds of decisions he or she had to make. Though the group should work together on researching this information, have each group member document the information individually for use in later steps.

4. Assign exploration groups, and introduce the deep-sea expedition simulation.
Reassign students to new exploration groups so that each new group includes one expert on each researched *DEEPSEA CHALLENGE* team member. Explain to students that they will be going on a "deep-sea expedition" with these groups, and each person in the group will act as the team member about whom he or she is an expert. Explain that students in each group will work together as a team to plan their deep-sea expedition to collect data in Earth's ocean that could be used to help investigate the following hypothesis: There are life forms in the oceans of Europa, a moon of Jupiter, that are similar to life forms found in deep-sea hydrothermal vent communities on Earth.

5. Have students begin the simulation by identifying expedition goals through research and

assigning responsibility among expedition team members.

Have students research the hypothesis they are to test. In their expedition groups, have them read and discuss the provided online article "Looking for Life" about Kevin Hand's work as it relates to hydrothermal vents and planning an expedition to Jupiter's moon, Europa. Ask: *Why is Kevin Hand, an astrobiologist, interested in hydrothermal vents in the deep ocean?* (He is interested in hydrothermal vents on Earth because he knows that understanding the limits of habitability on Earth will help scientists determine where to look for life on other planets.) *Why does Hand think that Europa might have hydrothermal vents?* (Because of the tidal interactions between Europa and Jupiter, the seafloor of Europa could be very active geologically.) *How might life forms that live near hydrothermal vents on Earth be similar to life forms on Europa*? (They might both use chemosynthesis as the basis for energy.) *How does this information apply to the expedition your group is planning*? (Knowing what kinds of life forms on Earth might be similar to any life forms that might be on Europa will help students determine where to explore on Earth to gather more information as well as what kinds of information to gather.) In their groups, have students discuss how this article relates to the goals of their expedition, and instruct students to write the goal of their expedition in one or two sentences. Have students determine the role of each expedition team member. Have expedition groups identify areas of responsibility for each team member. Students should specify which expedition members have decision-making powers over which topics and should indicate which team member has final decision-making power.

6. Have students plan their expedition using the Deep-Sea Expedition Project Proposal Plan.

Distribute the Deep-Sea Expedition Project Proposal Plan worksheet and Deep-Sea Expedition Rubric to each group. Review the proposal plan and rubric with students and answer any questions they might have. Have each group complete the Deep-Sea Expedition Project Proposal Plan for their expedition. Explain that students must give their proposals to the potential funder (the teacher) for approval before their expedition will be funded. Review each group's proposal, taking on the role of the funder. Provide feedback and ask specific questions about the plans to prompt deeper thinking. Have each group make any necessary adjustments to their plan before approving it for funding.

7. Have students analyze James Cameron's decision-making process using a cascading consequences diagram.

Congratulate all of the groups for getting their Deep-Sea Expedition Project Proposal Plan worksheets approved. Explain that even though careful planning goes into expeditions, often times things don't go as planned and explorers have to face unexpected challenges. Tell students they are going to watch a video about a challenge that James Cameron faced during the *DEEPSEA CHALLENGE* expedition. Provide students with the following focus questions: *What were Cameron's possible choices when he faced this challenge?* (He could have aborted the dive and tried again another time, or he could have continued without the backup safety system.) *What were the consequences Cameron had to consider in making a decision in this situation?* Have students identify information that will help them answer these questions as they watch the "Contingency Plans" video; then discuss the answers as a class. Show students the Sample Cascading Consequences Diagram handout and walk them through the process of creating the diagram. Explain to students that this chart analyzes James Cameron's decision-making process when a piece of safety equipment failed just before his historic dive, and he was faced with making a key decision. Ask groups to review the diagram. Tell them they will be creating their own cascading consequences diagram during their expedition.

8. Guide students through a simulated expedition and share their outcomes with the class.
Explain that like James Cameron and his team, students' groups might encounter unexpected challenges with their planned expeditions. Have students review their project plans. Then use the Expedition Simulation teacher sheet to guide students through a simulation of the process of mounting the expedition. Pause after each challenge for groups to decide what to do. Have each group record their decision and their rationale for their decision in a cascading consequences diagram. After the simulation, have each group briefly explain how they handled each challenge with the help of their cascading consequences diagram, and present the outcome of their simulated expedition.

9. Have a class discussion on the students' experiences in the simulation.
Have students reflect on the decision-making process in a class discussion. *Ask: Did the outcomes differ for different groups? How? What might have caused any differences in the outcomes?* Prompt students to share their groups' decision making processes. Ask: *How did your group make decisions? Which parts of your decision-making process worked well? Which did not? What was the biggest challenge of working with a group to make these decisions? What was the biggest advantage of working with a group? Would you anything differently next time?*

Tip

For step 9, consult the “Learning to Make Systematic Decisions” article listed in the For Further Exploration section for more background on cascading consequences.

Tip

If further information is needed on hydrothermal vents have students use the provided Vent Basics webpage and “Oceans: Hydrothermal Vents” video listed in the For Further Exploration section to further research hydrothermal vents and deep-sea exploration.

Modification

Modify step 5 for visual and auditory learners by showing them the video “Exploring Alien Oceans” instead of or in addition to having them read the “Looking for Life” article.

Alternative Assessment

Use the Deep-Sea Expedition Rubric to assess students’ project plans. Collect group's cascading consequences diagrams. Check that they include all challenges, and compare them to the Expedition Cascading Consequences Chart included in the Expedition Simulation handout.

Extending the Learning

Have students read about additional members of the *DEEPSEA CHALLENGE* team profiled in “The Team” article on the *DEEPSEA CHALLENGE* website. Ask them to select one or two additional team members who would have been helpful in meeting one of the challenges they were given during the simulation. Ask students to list the name and role of the team member, describe the challenge, and explain why the team member would have been helpful in dealing with the challenge.

Ask students to reflect on the *DEEPSEA CHALLENGE* team members' careers. Which career would students most like to have? Why? Have students research and write a short paragraph about the career of their choice, including what aspects of that career they would personally enjoy.

OBJECTIVES

Subjects & Disciplines

- Arts and Music

  Earth Science
  - Astronomy
  - Oceanography
- Engineering

  Geography

Learning Objectives

Students will:

- research a member of the DEEPSEA CHALLENGE expedition team
- use decision-making strategies to plan a deep-sea expedition
- work within cooperative groups to react to challenges in an expedition scenario

Teaching Approach

- Learning-for-use

Teaching Methods

- Cooperative learning
- Discussions
- Reflection
- Research
- Simulations and games

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- Critical Thinking Skills
  - Analyzing
  - Applying
- Geographic Skills
  - Answering Geographic Questions

National Standards, Principles, and Practices

NATIONAL SCIENCE EDUCATION STANDARDS

• **(9-12) Standard G-1:**
Science as a human endeavor
• **(9-12) Standard G-2:**
Nature of scientific knowledge

OCEAN LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

• **Principle 7a:**
The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.
• **Principle 7f:**
Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

Preparation

What You'll Need

REQUIRED TECHNOLOGY

- Internet Access: Required

- Tech Setup: 1 computer per small group, Projector, Speakers
- Plug-Ins: Flash

PHYSICAL SPACE

- Classroom
- Computer lab

GROUPING

- Large-group instruction

BACKGROUND & VOCABULARY

Background Information

On March 26, 2012, National Geographic Explorer-in-Residence James Cameron made a historic solo dive to the bottom of the Mariana Trench. Cameron's deep-sea exploration vehicle, *DEEPSEA CHALLENGER*, was only the second manned vehicle to reach the lowest-known point in the ocean, the Challenger Deep in the Mariana Trench, nearly 11 kilometers (7 miles) beneath the surface. To make this historic dive, Cameron relied on a team of more than 100 people in disciplines ranging from engineering to biology to film production. The team worked together to build the *DEEPSEA CHALLENGER,* determine the goals of the expedition, handle the logistics of testing the sub and making the final dive, and analyze the data and film footage Cameron brought back. Explorations and scientific endeavors of all kinds almost always involve the work of teams, and without the collective efforts of the *DEEPSEA CHALLENGE* team members, Cameron's historic dive would not have been possible.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
consequence	*noun*	result or outcome of an action or situation.
simulation	*noun*	a teaching method/strategy in which students sometimes use role play in a staged replication of an event or concept through the teacher's manipulation of the classroom setting in order to enhance students' understanding of the nature of the concept or event.

For Further Exploration

Video

- National Geographic Education: Deep Sea Hydrothermal Vents
- Exploring Alien Oceans

Websites

- National Science Teachers Association: Learning to Make Systematic Decisions
- Woods Hole Oceanographic Institution: Dive and Discover—Vent Basics

FUNDER

Alfred P. Sloan Foundation

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